More floods to come

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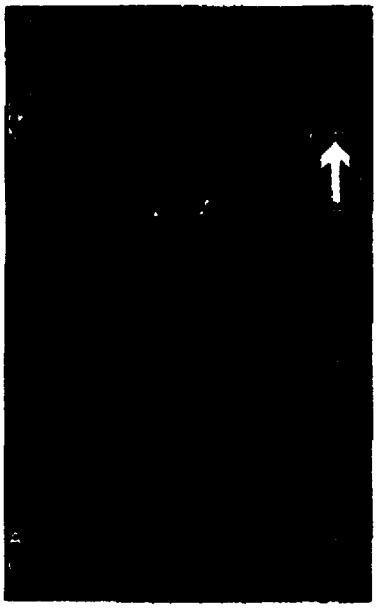
nature science update

## More floods to come

Build on hills, modelling of past and present climate warns.
*31 January 2002*

HEIKE LANGENBERG



The flood warnings are out again in the UK this week. Last year, record rainfalls hit England, causing widespread flooding. Around 11,000 people were evacuated from homes and businesses and the railway network was brought to its knees. Two studies now show that the future may hold many more sandbagged river banks and submerged streets.

Climate scientists shrug off the question of whether the catastrophic winter of 2000 was a taste of climate change to come, or if it was just extraordinarily wet, a freak event unlikely to recur in the near future. "Scientifically, this is not a meaningful question," says Tim Palmer of the European Centre for Medium-Range Weather Forecasts in Reading, UK.

But seeing the devastation, Palmer decided to probe the connections between catastrophic flooding and changing climate. With Jouni Räisänen of the Rossby Centre in Norrköping, Sweden, he rephrased the question into one more scientifically meaningful: will the risk of extreme rainfall increase in a changing climate[1]?

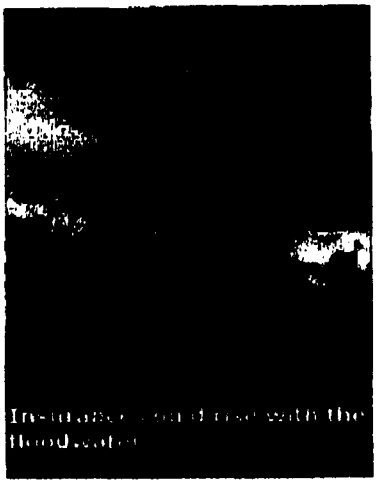
Their answer is yes. Extreme winter rainfall will become five times more likely over parts of northern Europe within the next 50 to 100 years, Palmer and Räisänen calculate. They predict similar increases in parts of southern Asia, affecting countries such as Bangladesh, where disastrous floods have displaced millions of people in recent years.

This gloomy prognosis is backed up by work from Christopher Milly of the Geophysical Fluid Dynamics Laboratory in Princeton, New Jersey, and co-workers[2]. They find evidence of increasing numbers of great floods in the largest river basins globally over the past 100 years, and agree that floods are likely to continue to become more frequent.

More floods to come

Costing the earth

Munich Re, the world's leading re-insurance company, employs 20 specialists in its Geoscience Research Group to forecast natural disaster damage. About half of them work on weather and climate.



So far, cost calculations have been based on the frequency and size of past claims. But in a changing climate, this may not be sufficient. "It's like driving a car by looking out of the back window," says Thomas Loster, one of the group's weather and climate experts. "Insurance companies are now thinking about quantifying likely future changes and adjusting their premiums to take increasing costs into account," he adds.

But putting a figure on changes in catastrophic events is much harder than estimating global mean temperature, for example. Their rarity, and the erratic nature of the background weather, make normal fluctuations and extraordinary trends hard to distinguish.

Whither the weather?

To forecast future climate, scientists use computer simulations To derive the best possible estimate, Palmer and Räisänen analysed the results of the 19 currently-available climate simulations for the effects of greenhouse gases - an idea borrowed from the related realm of weather forecasting. They compared these results with simulations of climate before human intervention.

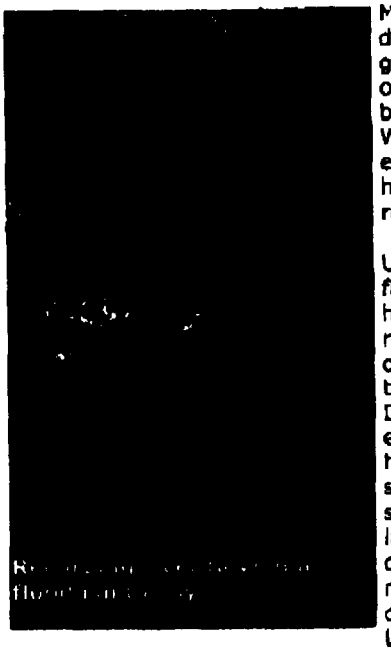
Like the day of the Punxsutawney ceremony in the film Groundhog Day, the same time period is covered again and again, with each run a slight variant on the last. "For the forecast of a severe storm, like the one that hit Germany in December 1999, we typically run the model 50 times," says Palmer.

**I wouldn't want to claim our approach is good enough**

If a severe storm develops in five of the 50 runs, the event is assigned a probability of 10%. "If you want to tow an oil rig into place, even a 10% chance of heavy weather means it would be better to wait until next week," says Palmer. The larger the number of simulations, the better the estimate of the probability of a specific event. The costs of running the model limit how many repetitions are done.

The researchers assume that the available 19 simulations cover the range of potential climate changes reasonably well - they use the best information currently available. "Our approach is pragmatic," concedes Palmer "I wouldn't want to claim this is good enough."

Water under the bridge



Meanwhile, Milly's team has discovered that 16 of the 21 great floods that have occurred since records began happened after 1953. Without global change, extreme events would be highly unlikely to pile up in recent years like this.

Unfortunately, accurate flood measurements are hard to come by. In a flood, river water rises and flows over river banks, through trees and houses. Determining river flow is even more difficult in the high waters that occur in spring, when ice floes are swept to the sea along with large masses of water. "It is dangerous to make measurements in these conditions," says Dennis Lettenmaier of the University of Washington.

Both new studies refer only to the wettest regions on Earth. Determining how the world's deserts would be affected will require further research.

Social norms

To sociologists, if not insurers, extremes are more interesting than the climatic norm. "I am convinced that it is primarily climatic extremes that leave their imprint on society," says sociologist Nico Stehr of the Institute for Advanced Study in the Humanities in Essen, Germany. "Human history can be written as human emancipation from climate," he says.

**Human history can be written as human emancipation from climate**

In Stehr's view, we have spread over almost the entire globe by creating stable environments - using heating and air conditioning to make houses from Florida to Alaska resemble the conditions in East Africa, where we evolved.

But these stable environments can be disturbed. Stehr cites the example of fourteenth-century England, where three consecutive years of extremely wet summers (1315-17) caused harvest failures that reduced the population so catastrophically that it took more than a century to recover.

Today, the impact of extreme rainfall in Northern Europe is unlikely to be anywhere near as devastating - most here have the means to protect their lives, if not their property. The same is not always true for those in the less wealthy parts of the globe. According to Palmer and Räisänen, Bangladesh will have to cope with more extreme monsoons on top of predicted increases in sea level.

In spite of all the warnings, Europeans seem to find living on river banks more and more attractive. Flood insurance costs are not yet high enough to influence people's decisions about where they live.

But those in the know put their money where their predictions are. Palmer and Milly both have houses on hills, well above the

[redacted]

potential perils of the floodplain.

**References**


1. Palmer, T. & Räisänen, J. Quantifying the risk of extreme seasonal precipitation events in a changing climate. ***Nature***, **415**, 512 - 514, (2002).
2. Milly, P.C.D., Wetherald, R.T., Dunne, K.A. & Delworth, T.L. Increasing risk of great floods in a changing climate. ***Nature***, **415**, 514 - 517, (2002).

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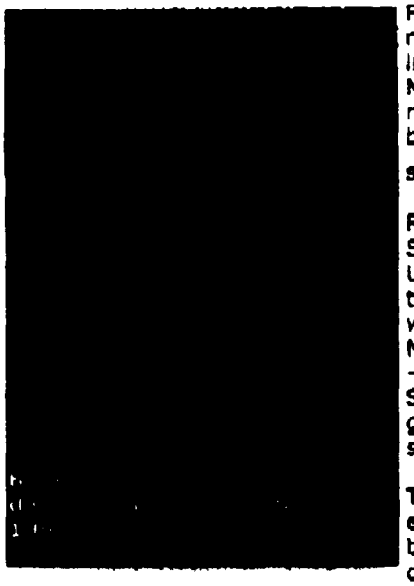
## Defence worsens flooding

River engineering is doing more harm than good.
*28 September 2001*

**PHILIP BALL**



Flood-management measures may be increasing the risk of the Mississippi and other rivers bursting their banks, new research suggests[1].

Robert Criss and Everett Shock of Washington University find that, for the same total amount of water flowing down the Mississippi - its discharge - the annual floods in the St Louis region have been getting steadily higher since 1860.

The flood of 1993, for example, was triggered by about the same discharge as that of 1903 -but was about 12 feet higher, causing billions of dollars' worth of damage in the river basin. Tens of thousands of acres of farmland were inundated and their crops destroyed, roads and bridges were damaged, and thousands of people had to flee their homes.

This kind of thing wasn't meant to happen any more. The Mississippi is supposed to be protected by 29 locks and dams north of St Louis, hundreds of canals, and artificial embankments (levees) along its banks.

That protection, say Criss and Shock, is precisely the problem. The changes in flood hazards over time "are far more dependent on human activities than on the amount of flood water in the river", they point out.

The duo compared the rising flood levels of the middle Mississippi - the St Louis region - with flood records of the Ohio, the Meramec and the Missouri rivers. This last joins the Mississippi upstream of St Louis.

The lower Missouri and middle Mississippi have been heavily engineered, constrained by artificial channels and high levees. Both have risen.

**Certain management practices should be reconsidered**

But on the upper Missouri, above Fort Benton, there are few flood-control measures - and no evidence that flood levels have risen significantly for more than a century. The same is true of the Meramec in eastern Missouri, where locals have resisted attempts to engineer this river's course. The minimally defended Ohio river in Cincinnati has a similarly unchanged flood record.

"The evidence," say Criss and Shock, "indicates that levee construction and channelization of the lower Missouri and the middle Mississippi have greatly magnified their floods." The researchers add that "this effect is increasing and shows no signs of stopping".

"Certain [flood] management practices should be reconsidered," say the researchers. They suggest that the lower Missouri should be allowed to return to its natural braided form rather than being confined within high, narrow banks.

**References**

1. Criss, R. E. & Shock, E. L.. Flood enhancement through flood control. ***Geology***, **29**, 875 - 878, (2001).